Regional and Remote Communities
Reliability Fund Microgrid

# MyTown Microgrid

## Description of the decision support tool for grid-tied microgrids (Beta version)

Milestone 4 July 2022

wattwatchers DIGITAL ENERGY
Federation University
Public Interest Advocacy Centre
LATROBE VALLEY AUTHORITY
RMIT UNIVERSITY
community power agency
HEYFIELD COMMUNITY RESOURCE CENTRE
UTS
AusNet Services

## Research Team

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## Key support

Wattwatchers Digital Energy

Heyfield Community Resource Centre

Latrobe Valley Authority

AusNet Services

Federation University Australia

## About the project

MyTown Microgrid is an innovative, multi-year, multi-stakeholder project that aims to undertake a detailed data-led microgrid feasibility for the town of Heyfield (Victoria), built on a platform of deep community engagement and capacity building.

The project received funding under the Australian Government's Regional and Remote Communities Reliability Fund Microgrids stage 1 funding round. It also received funding from the Latrobe Valley Authority as part of the Gippsland Smart Specialisation Strategy.

## Decision Support Tool for grid-tied microgrids – Beta

The Beta version of the Decision Support Tool (DST) presented here showcases the structure of the tool developed to support communities in the early stages of decision making about local energy systems. We anticipate commencing testing with the Community Reference Group, Steering Group, and wider project team by 31/8/2022.

The MyTown project will then release the initial version for feedback from the broader Heyfield community and other community energy stakeholders, to ensure that the tool contains adequate detail, resources and preliminary analysis techniques to genuinely support microgrid projects in early decision-making stages. It is anticipated the next major version will be ready for testing with the wider community in early October 2022.

The tool has been built as a Miro board https://miro.com/app/board/uXjVOjaNKts=/?share_link_id=667589465680[1] and flowchart which allows the following features:

- A slide presentation to allow the user to take a curated journey through the tool.
- Links that allow the user to navigate to and between those elements that best suit their needs.
- The support for embedded links to additional resources, linked datasets and calculators
- Publicly viewable on tablets, phones and computers – although with the volume of information, larger screens are recommended.
- The ability to expand the tool in future.

Included in this report are printed versions of the following slides, noting these are interactive on the online version:

*Introductory Information*



[1] Note this link will not work for the later versions of the Beta DST

During the next phase of development Information resources will be added to cover:

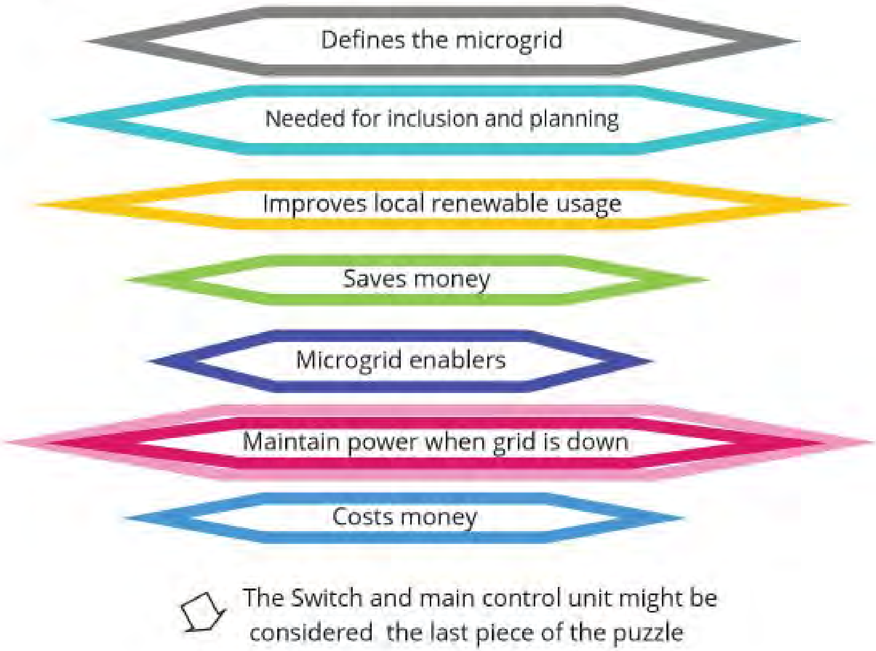
1. Further information on additional microgrid building blocks
2. Resilience and Energy
3. How electricity networks are operated
4. Models for site level initiatives
5. Models for community level initiatives
6. Potential 10 year plans and community journeys
7. Advocacy and Partnerships

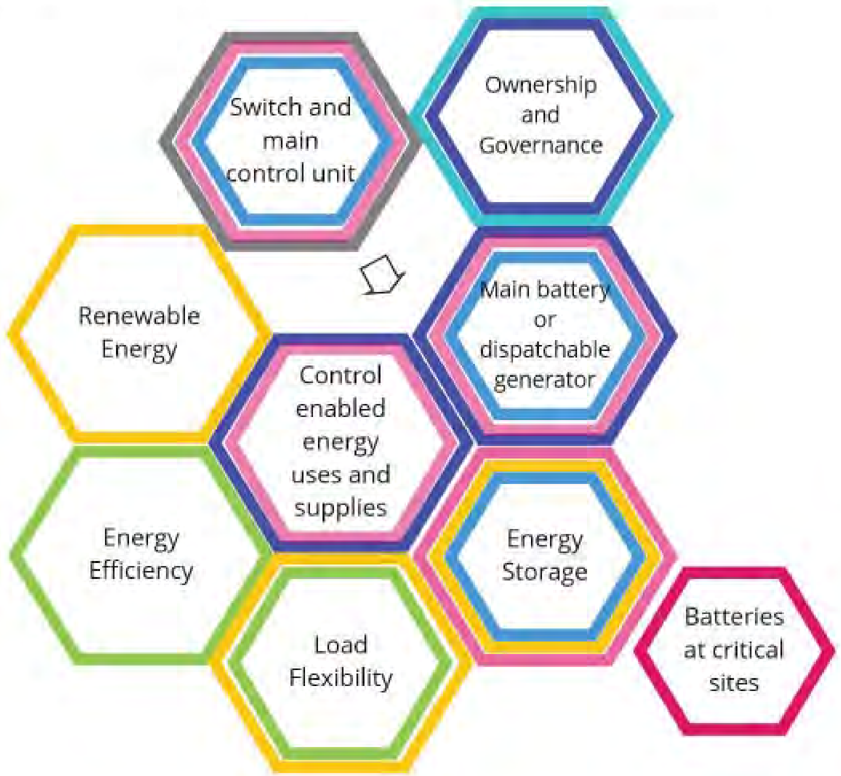
**The following Decision support tool will take you through each of the microgrid building blocks to help you explore where to start on your microgrid journey***
*warning - you may not need a microgrid!

see also caveats for use of this tool

# Microgrid Building Blocks

## **Legend:** Contribution made by each building block




Click blue arrow to get started

not quite ready?..read What is a microgrid?

## Switch and main control unit

The ability to disconnect from the main grid** is the defining feature of a microgrid. You will identify a **switching point** on the main grid. Everything downstream from that point will form your microgrid boundary (ie everything that normally relies on its electricity supply coming through that switching point will need to be served by the microgrid when the switch to the grid is off). This is known as "islanding".
Microgrids come in many sizes. A small microgrid might provide 100kW of electricity to just a few customers. A larger system can be 2-20MW and serve whole townships of 1,000 to 10,000 households. Most of the microgrids in Australia are remote systems, many 100's of km from the main grid with diesel generators and slowly being supplemented by renewable supplies and batteries. On-grid microgrids are a newer concept in Australia and will suit communities with poor power supply. The operators of the main grid have recently been allowed to remove main grid supply if they offer a microgrid or stand-alone alternative, so the benefit of having both a microgrid and a main grid supply option will be removed in these cases. This tool assumes you are trying to make the case for a microgrid as a supplement to your main grid supply.
When your community is connected to the main grid, the larger system matches ***precisely*** the amount of electricity needed with the amount supplied. This keeps the voltages and frequencies of the grid stable. A microgrid needs a **main control unit** to play this precise matching role when the microgrid is in 'island' mode. Traditionally the governor of the diesel generator played this role. Newer systems with batteries use a grid-forming inverter.

**If you are not connected to the main grid, then you are already part of a microgrid. Your first step needs to be understanding the current ownership and management arrangements and the ways that you might get involved.

## Main battery or dispatchable generator

The easiest way to control the matching of supply and demand is with a large asset that can respond easily to the amount of electricity being demanded by providing more or less electricity. This asset needs to be available day or night. This is one of the main expenses of a microgrid so designers will try to size this asset in an optimal way - too small and the microgrid won't be able to serve the largest loads, too large and the microgrid costs will rise. This capacity of this asset is supplemented by controlling other generation and loads (see control enabled energy uses and supplies, below). Every asset also has a failure rate so critical sites (for example) will sometimes have two back up generators to provide backup to each other as well.

Batteries are still expensive but costs are falling. They are well suited to 1-2hr nightly cycles, rather than being designed for faults of longer duration. Batteries, of course, can also soak up surplus renewable energy so they provide an ideal balancing load.

Many communities will not want to rely on a diesel generator and renewable fuels for backup generators are future alternatives. For long periods without power, generators remain the cheapest to own, even though they are expensive to run. Outages for long periods are more likely during crises caused by stormy weather which coincide with periods of low solar energy. Some network providers own mobile diesel generators, so designing a microgrid around the location of a plug-in spot for these assets might be an option.

## Ownership and Governance

If your microgrid is serving a diverse group of electricity users without an existing shared electricity arrangement, you need to think about who will own the key assets and how their use will be governed.
For a start, there are regulations to abide by if you:

1. Sell electricity. This is normally done by a retailer and customers cannot be forced to buy from you. There are some nuances around small networks that exist inside the electricity system, eg a retirement village with a single site owner, but even those must sell at a competitive price.
2. Transport electricity. Your poles and wires are owned by the main grid provider and they have distribution licenses with substantial supply obligations. Almost half of your electricity charges pay for the network including the transmission infrastructure to connect your community to Generators.
3. Connect a generator to the electricity grid. The main grid provider will need to understand how your generator will affect their network, and how it will disconnect from the main grid when a fault is detected.

Negotiating your relationships with these different providers in the electricity system is an important reason to have a group with the authority to speak, to some extent, on behalf of your community.
Ownership involves negotiations about finance and flows of benefits back to those who provide resources. It is useful to think through all the people who should control management decisions. Controlling energy assets will quickly become illegitimate if the right stakeholders aren't involved. Finally, engaging your community is essential to bring a critical mass of people on the microgrid journey with you.

## Energy Efficiency

Once you have considered the spatial reach of your microgrid, it is time to understand how much electricity you might need to provide. Some ways to proceed with quantifying the load are provided within this tool. When you are in a position to start modelling the total electricity load you will notice that electricity demand changes at different times of the day due to different activities, and across seasons, mainly with heating and cooling differences.

Energy Efficiency warrants an early discussion because the sizing of your main microgrid investments can be reduced if you don't serve wasteful loads. Energy efficiency is generally a sound way to reduce electricity bills and provide benefits to those who need it most, especially when it makes homes more comfortable. But energy efficiency activities take a lot of effort, which is why they have most often been provided and supported by governments - they are known as a market failure.

A microgrid design needs to think about all the electricity uses that need to be provided. Some may be shiftable to a cheaper time of day, some may be growing as we spend more on these types of appliances (eg large televisions, gaming), and falling as purchases meet higher star ratings (eg fridges and washing machines). New customers might arrive if land is developed and the local economy grows. New electricity uses will emerge as we change from gas appliances to cleaner electric alternatives and as the market for electric vehicles takes off.

Local economies will benefit if we use local renewable resources to provide our electricity. On the wholesale electricity market, wind and solar are

# Read More


Switch and main control

How electricity networks are operated

Main Battery or Generator

Governance & Coordination

Energy Efficiency

## Renewable Energy

Local economies will benefit if we use local renewable resources to provide our electricity. On the wholesale electricity market, wind and solar are the cheapest forms of electricity and can cause prices to go negative when they are in surplus, meaning you can sometimes be paid to use energy!

A microgrid with adequate local renewable supplies will be able to operate for extended periods without the main grid. This is the ideal scenario for most communities, but unfortunately slightly out of reach financially at the moment. The mismatch between our ambitions and current costs is mainly caused because solar energy is the most abundant renewable resource but the electricity required to provide power all night leads to battery costs that are unaffordable. A microgrid design is therefore a balancing act between generating enough electricity, using it at the best times and storing some surplus for the times that cannot be matched directly.

This tool provides indicative costs and quantities for your most likely renewable energy options. It will give you an idea of how renewable energy can save you money part of the time, and the work you need to do to make better use of your cheap renewable energy. These fundamentals make a microgrid possible because the savings from cheaper energy can help fund the main microgrid investments. However, if your aim is self-sufficiency or increased renewable energy use, you don't need a microgrid at all and you could develop the strongest value flows by continuing to trade with the main grid at key times.

Renewable Energy

## Control enabled energy uses and supplies

Traditionally our electric hot water has been controlled by a timer or a signal from the grid provider to heat up overnight when the electricity was cheap. We are desperately in need of an upgrade. The good news is that appliances are increasingly suitable for connection to control signals. Like energy efficiency though, enabling control will suffer from some market failures and will benefit from supporting the site owner through the myriad of decisions and options. What does this have to do with a microgrid? The more generators and appliances that can be controlled remotely, the more contribution each can make to stable operation of the microgrid when needed. This will also reduce the capacity and investment needed at the Main battery or Dispatchable Generator.

Generation: the newest solar inverters can provide power to the home even when the main grid fails. Like a battery on a Stand Alone Power System, these inverters need to control a switch at the site metering point because nothing is allowed to produce electricity onto an unpowered grid, so the site must be diconnected. Even without the stand-alone facility, new solar systems can be controlled via signals to limit export levels, so the output can be ramped down when necessary.

Hot water remains the largest load at home and a likely candidate for flexibility, a tank of hot water is simply energy storage after all. Other appliances can be classed as discretionary and can be placed on timers or awaiting automation signals. Pool pumps have been used successfully by some electricity retailers and in future it may be expected that many appliances like washing machines can be delayed in their cycles when necessary.

Flexibility & Control

## Load Flexibility

Load flexibility offers an opportunity to move load to a cheaper time of day. It relies on an energy use that doesn't need to happen straight away, or an energy use that holds its energy to some extent. Heating and cooling can often occur 15 minutes to 2 hours earlier depending on the thermal mass of the building and how it holds the energy and maintains the temperature.

A microgrid needs to be able to deploy flexible loads when there is surplus renewable energy, and defer them when scarce supplies, like battery capacity, need to be made to last longer. In the main grid, the same dynamics are at play. Flexible loads can use cheap surplus solar during the day rather than fossil fuels at night. Matching wind power is even less predictable, so during winter flexible loads may be the ideal asset to turn on whenever surplus wind is available.

Batteries are the ultimate flexible load because they can generate electricity when they are not soaking up surplus.

The design around the use of flexible loads and associated control systems is a critical element in achieving the best local energy outcomes, and will depend on your aims.

Flexibility, fuel switching & Control

## Energy Storage

## Batteries at critical sites

Batteries will be a critical part of the energy future. They will be managed with other forms of storage. Hydro power stores water, fuels of all description, are forms of energy storage including biofuels and hydrogen. The large move toward electric vehicles means that many people will have access to one giant battery in their vehicle. No one knows if household batteries will be replaced by vehicles that can power the whole house, or if vehicles that can sell electricity to the grid will remain a technology fantasy. Pumping, hot water, and other thermal loads all work with an element of storage and should also be considered as part-fulfilling the role of storage in a microgrid, or at least reducing the capcity needed in the Main battery or Dispatchable Generator.

Batteries come with a high cost but also a business case. The battery that soaks up surplus solar every day and offsets expensive grid electricity at night can be cost-effective. Adding a role as a backup energy supply to this investment can make it worthwhile for every site which provides critical services to a community or places a high value on business continuity.

A microgrid will benefit from control and communications capability with every battery across its community.

Energy Storage

Batteries at critical sites

Back to Microgrid Journey

# Using the Microgrid Decision Support Tool - Caveats

This decision support tool is aimed at ***grid-connected microgrid*** investigations. Stand-alone Power Systems and Off-grid microgrids have some quite different considerations.

**Who is this for?**
This tool is intended for communities as they start enquiring about energy transformation. It tries not to be too technical. It also allows the user to explore the parts of most interest, and to return multiple times as users learn more about microgrids, local energy systems and their own unique circumstances.

**What are its limitations?**
The tool will not work for every situation. It provides resources and simplified advice in order to get communities started on a journey, and direct analytic efforts in the best direction. It does not displace an ultimate need for technical expertise, detailed investigations and community engagement.

**How much of the advice can be relied on?**
It is always worth cross-checking advice. Technology costs, regulation and prices from market settings are always changing. This tool only aims to get you started.

**We value feedback.** The tool has been developed in this form so that it can continue to be augmented with richer insights and useful tools. Email us to offer your suggestions. You can find out more about the MyTown Heyfield microgrid and local energy investigations via Heyfield CRC or UTS. For general resources about community energy in Australia go to the Coalition for Community Energy Knowledge Hub.

## Shortcut to all slides on this decision support tool

### On site and sometimes community level investment options

- Renewable Energy
- Energy Efficiency
- Flexibility & Control
- Energy Storage
- Batteries at critical sites

### Key Microgrid Investments

- Switch and main control
- Main Battery or Generator
- Back to Microgrid Journey
- Next Steps after Microgrid Journey

### Getting Started

- Governance & Coordination
- Models for site level initiatives
- Models for community level initiatives
- Possible 10 year plans and journeys
- Resilience and Energy
- Early steps - microgrid modelling and design

### Getting Strategic

- Outcompeting the energy sector
- Advocacy and Partnerships
- Community engagement?
- benchmarks and tools, further research, don't know

### Getting Informed

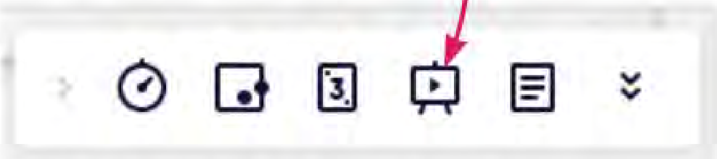
- What is a microgrid?
- How networks are operated
- SAPS, VPPs and other definitions

### Introduction and Navigation

- Back to Microgrid Building Blocks
- Using this tool - caveats
- How to use this Miro Board
- Table of Contents

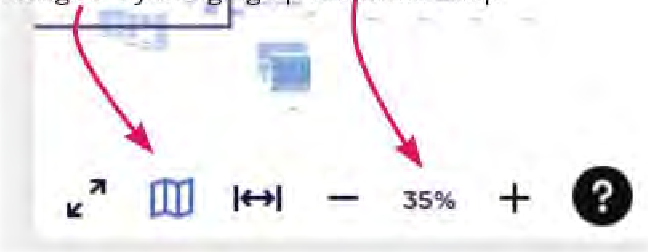
# Help! - Some tips to understand and navigate on this Miro Board

Tip 1 - you can opt for a slideshow by clicking on this symbol along the top right hand corner of your screen



By hovering at the middle bottom of the screen, you can click through each slide


Tip 2 - This section at the bottom right hand corner helps you Zoom, and navigate by bringing up the whole map




Tip 3 - Links like this one open a new tab in your Browser with a spreadsheet and resources / calculators for you to use. When you've finished, make sure you come back to the Miro tab

Tip 4 - Every slide has links to get you back on track - look for these three

Back to Microgrid Journey

How to use this Miro Board

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Final tips - these are the main shapes on the flow chart

Orange is a decision

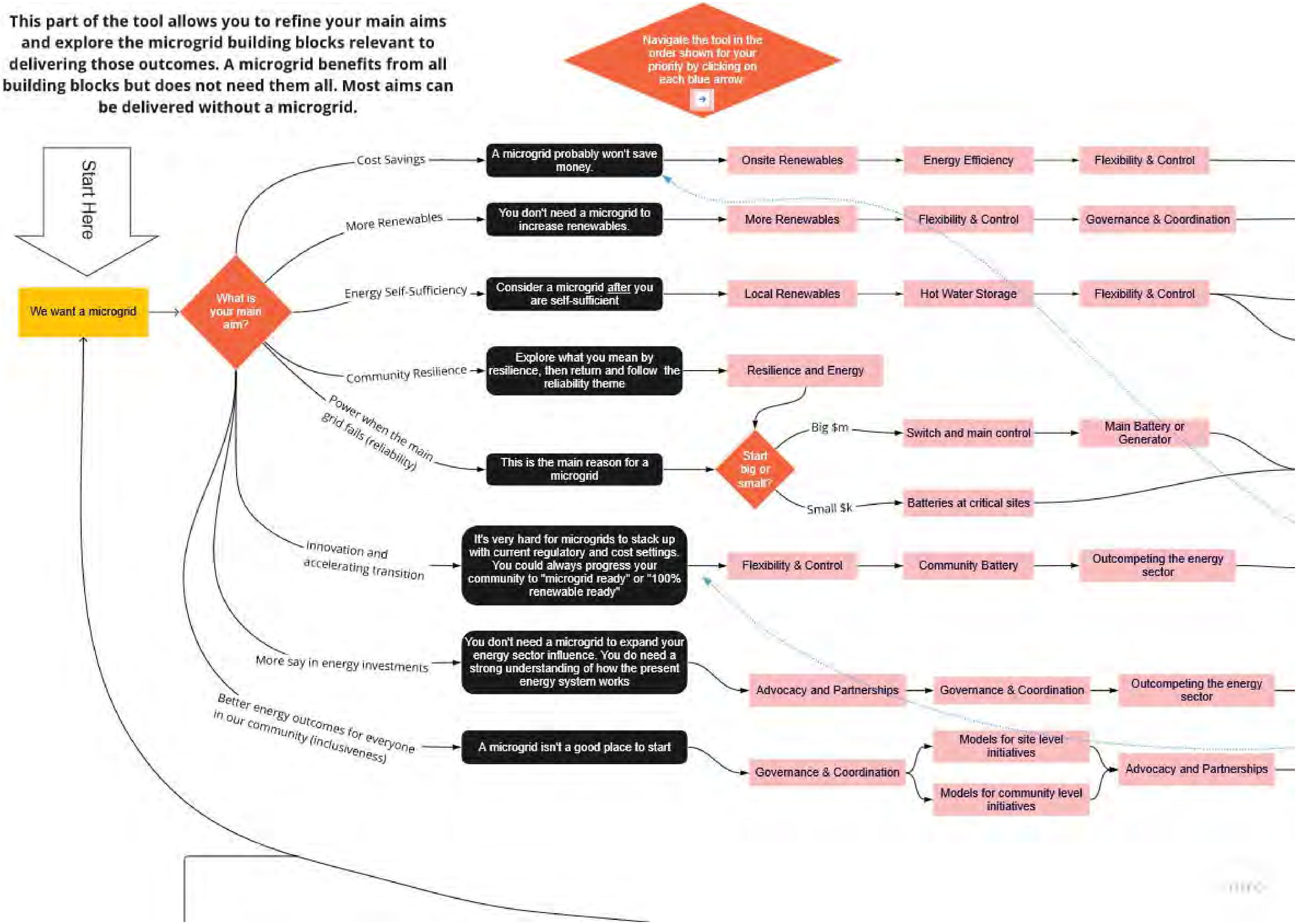
Gold is a start or an end

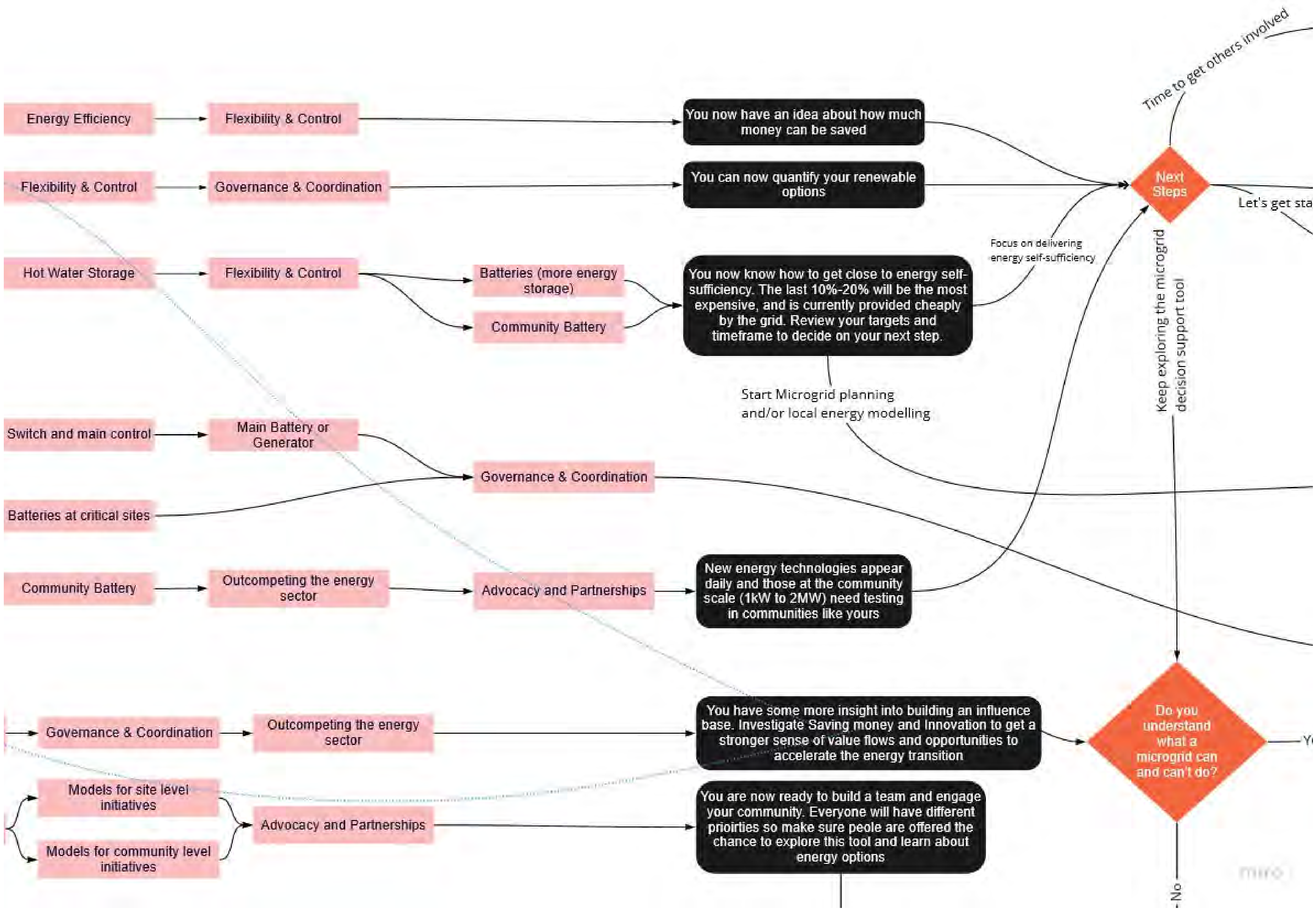
Black is a result or advice

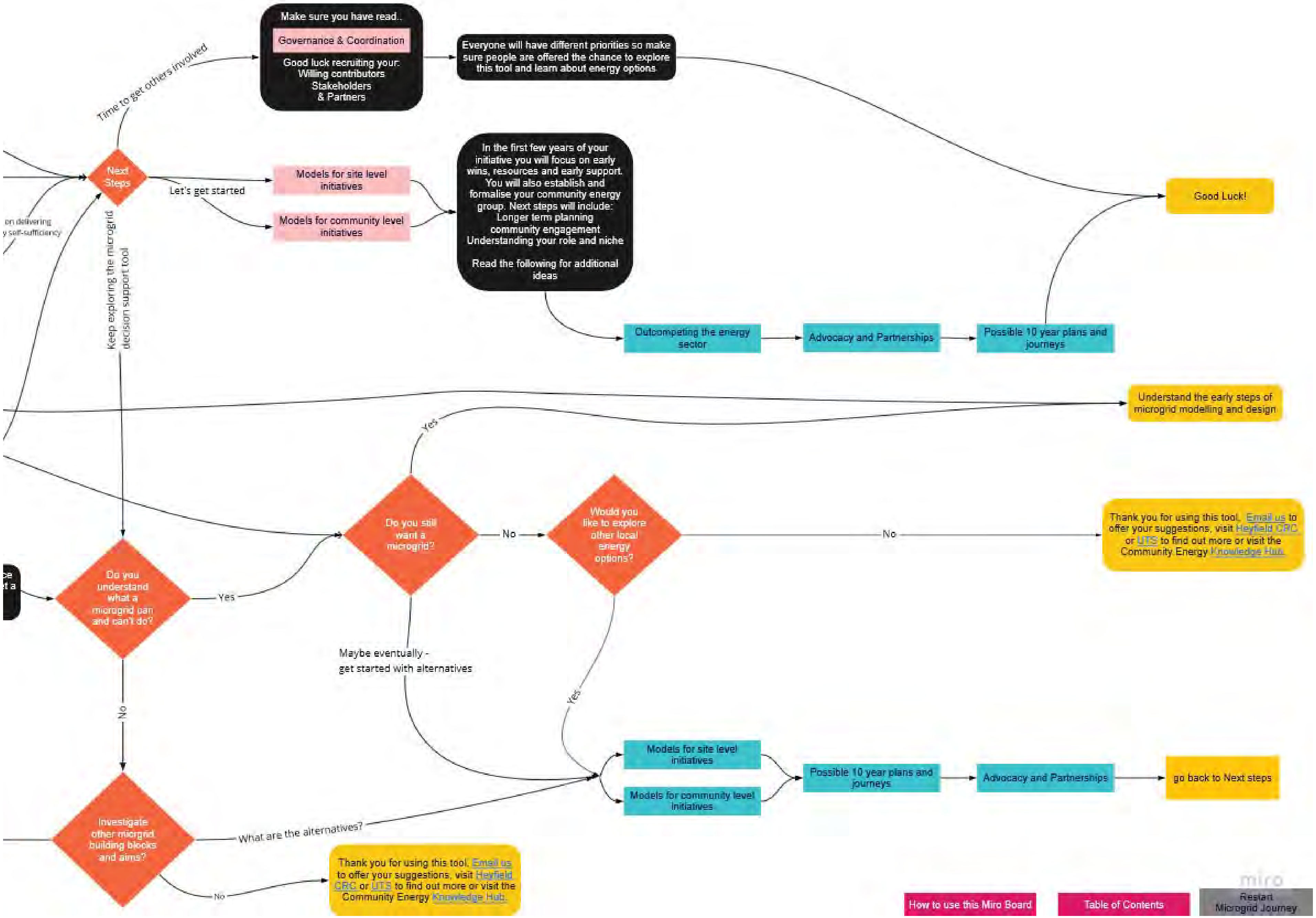
Navigation rectangle

These rectangles are many colours - note the blue arrow in the right hand corner, clicking on it will take you where you need to go next

**This part of the tool allows you to refine your main aims and explore the microgrid building blocks relevant to delivering those outcomes. A microgrid benefits from all building blocks but does not need them all. Most aims can be delivered without a microgrid.**




Energy Efficiency
Flexibility & Control
You now have an idea about how much money can be saved
Time to get others involved
Flexibility & Control
Governance & Coordination
You can now quantify your renewable options
Next Steps
Let's get sta
Hot Water Storage
Flexibility & Control
Batteries (more energy storage)
Community Battery
You now know how to get close to energy self-sufficiency. The last 10%-20% will be the most expensive, and is currently provided cheaply by the grid. Review your targets and timeframe to decide on your next step.
Focus on delivering energy self-sufficiency
Keep exploring the microgrid decision support tool
Start Microgrid planning and/or local energy modelling
Switch and main control
Main Battery or Generator
Governance & Coordination
Batteries at critical sites
Community Battery
Outcompeting the energy sector
Advocacy and Partnerships
New energy technologies appear daily and those at the community scale (1kW to 2MW) need testing in communities like yours
Governance & Coordination
Outcompeting the energy sector
You have some more insight into building an influence base. Investigate Saving money and Innovation to get a stronger sense of value flows and opportunities to accelerate the energy transition
Do you understand what a microgrid can and can't do?
Models for site level initiatives
Models for community level initiatives
Advocacy and Partnerships
You are now ready to build a team and engage your community. Everyone will have different prioirties so make sure peole are offered the chance to explore this tool and learn about energy options
No


Make sure you have read..
Governance & Coordination
Good luck recruiting your: Willing contributors Stakeholders & Partners
Time to get others involved
Everyone will have different priorities so make sure people are offered the chance to explore this tool and learn about energy options
Next Steps
Let's get started
Models for site level initiatives
Models for community level initiatives
In the first few years of your initiative you will focus on early wins, resources and early support. You will also establish and formalise your community energy group. Next steps will include: Longer term planning community engagement Understanding your role and niche
Read the following for additional ideas
Good Luck!
Keep exploring the microgrid decision support tool
Outcompeting the energy sector
Advocacy and Partnerships
Possible 10 year plans and journeys
Understand the early steps of microgrid modelling and design
Yes
Do you still want a microgrid?
No
Would you like to explore other local energy options?
No
Thank you for using this tool. Email us to offer your suggestions, visit Heyfield CRC or UTS to find out more or visit the Community Energy Knowledge Hub.
Do you understand what a microgrid can and can't do?
Yes
Maybe eventually - get started with alternatives
Yes
No
Models for site level initiatives
Models for community level initiatives
Possible 10 year plans and journeys
Advocacy and Partnerships
go back to Next steps
Investigate other micrgrid building blocks and aims?
What are the alternatives?
No
Thank you for using this tool. Email us to offer your suggestions, visit Heyfield CRC or UTS to find out more or visit the Community Energy Knowledge Hub.
miro
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Restart Microgrid Journey

# Switch and Main Control Unit

A microgrid is defined as a part of the grid that can be disconnected and operate independently. (known as island mode).

**This part of the tool explores your ongoing relationship with the main grid and helps you define the boundary of your microgrid** (which will determine the energy users that you will keep powered on during main grid blackouts.)

What does your electricity supply look like?

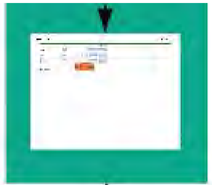
I don't know

Look up your grid provider in the spreadsheet below and try the links to find a map of your local electricity network:
..via provider direct; or
..via state govt maps; or
..via AREMI

click below then download or open spreadsheet in new tab

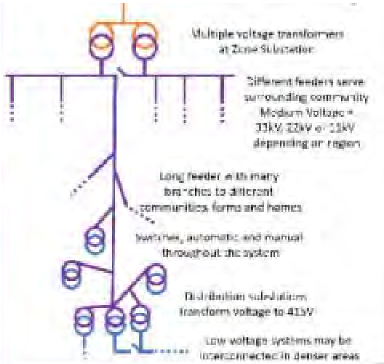
Feeder Types

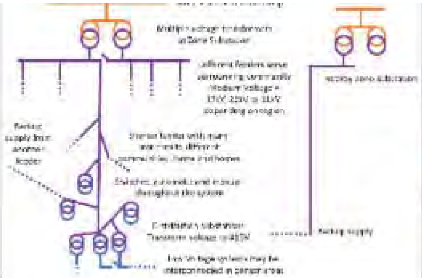
| Some names given by the grid providers | Long Rural Feeder | Short Rural Feeder | Urban Feeders |
|---|---|---|---|
| what it looks like on a map (Zoom in to see key features) |   |   |   |

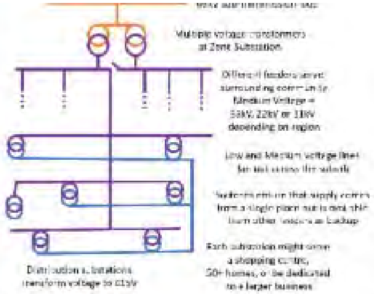


Don't forget to come back

**what it looks like on a circuit diagram**




**Reliability implications**
(Ausnet example)

How to use this Miro Board

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